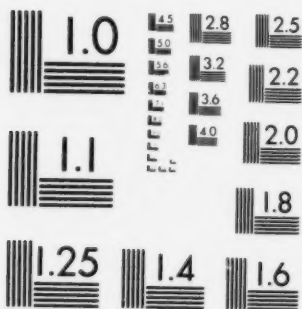


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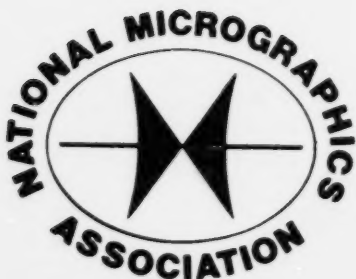


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Relationships among Wolves, Hunting, and Population Trends of Black-tailed Deer in the Nimpkish Valley on Vancouver Island

by G. W. Jones and B. Mason
July 1983



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RELATIONSHIPS AMONG WOLVES, HUNTING, AND
POPULATION TRENDS OF BLACK-TAILED DEER IN
THE NIMPKISH VALLEY ON VANCOUVER ISLAND

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July, 1983

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ABSTRACT

Populations of black-tailed deer (Odocoileus hemionus columbianus) were surveyed in the Nimpkish Valley annually from 1967 through 1983. Populations and annual recruitment were initially high, but were reduced by severe winters in 1968-69 and 1971-72. The deer population increased during the subsequent mild winters from 1973-1976, but remained below the levels of the earlier period. Hunting likely reduced the rate of recovery, but populations still exceeded the numbers supported by the winter ranges over the severe winters. Wolf (Canis lupus crassodon) populations then increased and reduced deer populations and harvests by over 75% in 6 years. Similar population declines occurred in an un hunted and unlogged watershed. Wolf activity was negatively correlated with annual recruitment and with rates of population change. The data indicate that from 1977 through 1983, predation by wolves held deer populations considerably below the potential determined by habitat and climatic conditions. It was concluded that substantial deer populations could only be maintained if habitat, hunting, and predation were all managed.



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INTRODUCTION

Early travellers through the forests of Vancouver Island noted significant populations of deer (Sheldon 1912). Since those early days the Columbian black-tailed deer have been a popular recreational resource.

Deer habitats are greatly influenced by logging on Vancouver Island. The early seral stages created by logging are often intensively used by deer (Willms 1971). However, extensive clearcutting eventually reduces deer populations by creating large areas of dense regeneration (Cowan 1956), and in areas having deep snow by removing old-growth habitats crucial to survival through periodic severe winters (Jones 1975).

There have been few detailed studies of the effects of hunting on deer populations on Vancouver Island. While heavy hunting pressure affects deer abundance, habitat and climatic conditions normally have the greatest effect on long term population levels (Smith 1968). The effects of hunting likely vary with effort relative to population size, climate conditions, habitat quality, and level of predation.

There have also been few studies of the relationships between predation and Island deer populations. Prior to the mid-1970's, it was thought that predation by wolf, cougar (Felis concolor vancouverensis), and black bear (Ursus americanus vancouveri) had minor effects on deer populations in most areas (Cowan 1956). However, this conclusion was reached when wolf populations were relatively low in relation to deer populations.

The deer populations within the Nimpkish Valley area of northern Vancouver Island have been surveyed annually by direct counts on spring and summer ranges for many years. This report summarizes the recent history and current status of the Nimpkish deer populations and discusses the relationships between population trends, winter range, hunting, and wolves.

We thank the Fish and Wildlife Branch, the University of British Columbia, and Canadian Forest Products Ltd., for financial and logistical support. G. Smith, H. Langin, C. Veasey, J. Mason, D. Lindsay, A. Harestad and others participated in the annual surveys. D. Hebert, R. Davies, A. Harestad, I. Hatter, and D. Eastman reviewed and improved the report. L. Stanlake prepared the figures and organized the publication.

STUDY AREA AND STUDY PERIOD

The study area was on northern Vancouver Island, within Fish and Wildlife Region 1, and encompassed approximately 2,000 km² (Fig. 1). The area included the watershed of the Nimpkish River, plus portions of watersheds of the Tsitika, Oktwanch, Kokish, Tahsish and Artlish Rivers. The central part of the Nimpkish watershed was studied most intensively and the whole study area is referred to as the Nimpkish.

Deer populations within the Nimpkish were surveyed annually from 1967 through 1983, although extensive surveys began in 1973. The annual surveys were organized according to geographical subunits as defined by the Fish and Wildlife Branch (Fig. 1). The subunits separate the various watersheds and mountain blocks into logical units for monitoring different deer populations within the study area.

The Nimpkish is mountainous, and elevations range from sea level to 1900 m. Valley bottoms in the intensively studied area range from 100 m to 400 m in elevation. Most data were collected from the Coastal Western Hemlock Biogeoclimatic Zone, but the Subalpine-Mountain Hemlock Zone and the Alpine Zone also occur in the Nimpkish.

Logging began in the lower Nimpkish about 1917 but most of the Nimpkish was developed after 1945. Logging continues today and is generally well dispersed throughout the area. At present, most of the Nimpkish is a mixture of recent cutovers, second-growth, and old-growth forest. However, some continuous clearcuts approach 2000 ha in size. Wildlife values were not considered in logging plans before 1973, and consequently, deer winter ranges were steadily depleted. By 1974, most of the remaining winter ranges were temporarily deferred from logging and the area of old-growth winter range has declined only slightly since then.

Most winters during the study period were considered mild, with insufficient snow to force deer onto restricted winter ranges for extended periods. However, the winters of 1968-69 and 1971-72 were severe and had deep snow for several months.

METHODS

Most of the deer population data were obtained by counting deer during day or night. All deer counts were made in logged habitats approximately 2-10 years old. Most deer use of cutovers occurs during nighttime (Harestad 1979), but substantial use also occurs during crepuscular periods.

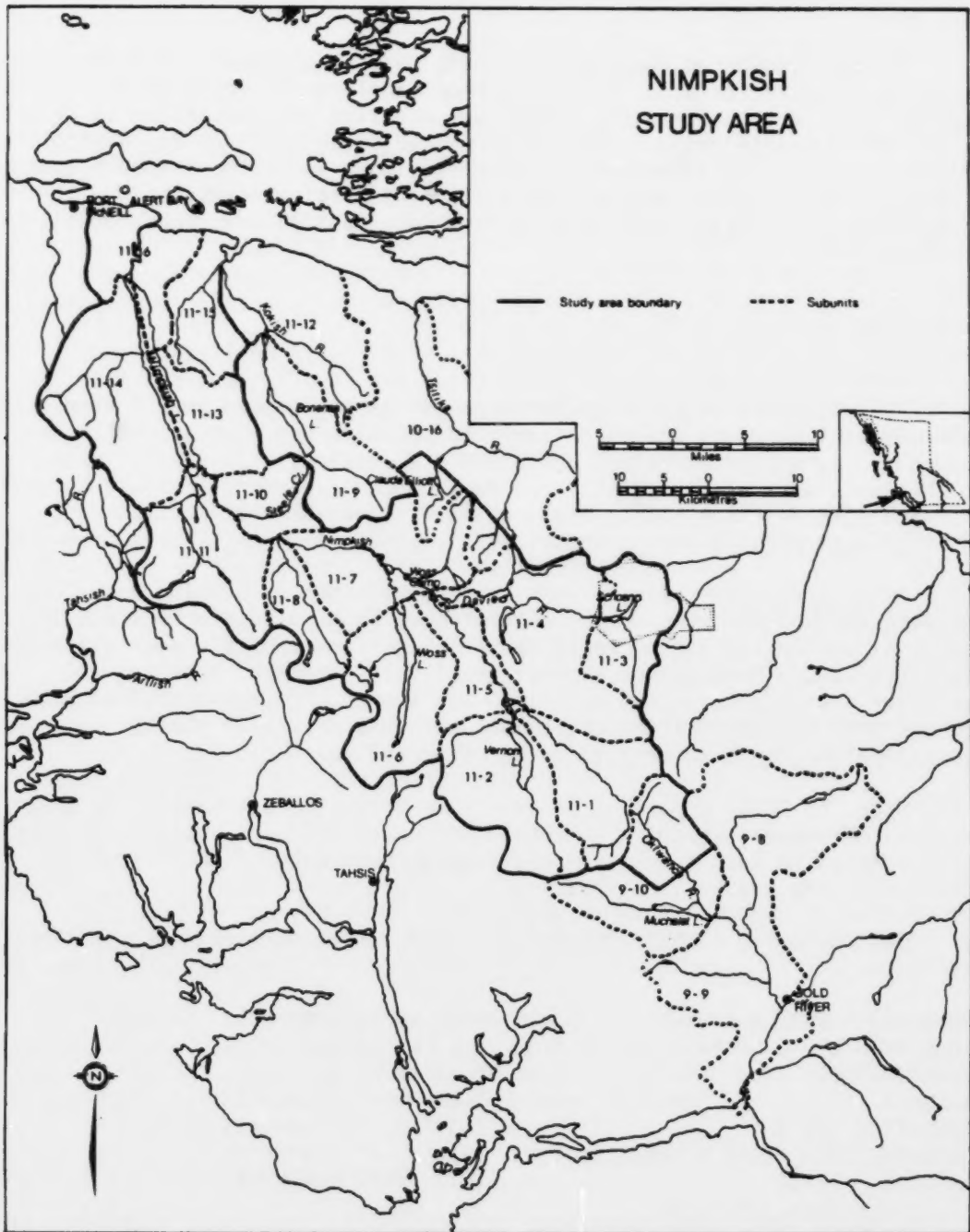


Fig.1. Location of subunits in the Nimpkish study area.

It was considered important to count deer on the same transects every year to minimize variation resulting from sampling different areas and deer herds. However, the transect system was modified when necessary to delete areas where conifer regeneration had reduced visibility, or to incorporate new transects resulting from continued logging. While the transect system changed over the study period, there were insufficient changes in geographical or seral class distribution to affect observed population changes.

NIGHTTIME DEER COUNTS

The objective of the nighttime counts was to compare annual population changes as indexed by counts in early to mid-May when most deer were concentrated on spring ranges below 650 m elevation. In several cases, nightcounts were also used to index deer concentrations on cutover summer ranges. The deer population index was calculated as deer counted per kilometre of logging road transect.

Deer using open cutovers were counted at night by shining hand-held spotlights from vehicles driven slowly along logging roads. The choroid layer of the deers' retina reflected the light and made the deer visible to the observer. There was no attempt to classify the deer seen but when the observer was uncertain that an animal was a deer, it was identified with binoculars. Details of the nightcount method and related statistical considerations were summarized by Harestad and Jones (1981).

Prior to 1975, a portion of available transects was sampled in the various management subunits. From 1975 through 1983 all possible transects were sampled in each subunit (except where roads were blocked) so that the study area was well covered.

The following ranges of total transect length were obtained in the subunits:

Subunits	9-10 and 11-1	:	18-50 km of transects
Subunit	11- 2	:	8-15 km of transects
Subunit	11- 4	:	15-48 km of transects
Subunit	11- 5	:	3-18 km of transects
Subunit	11- 6	:	4-18 km of transects
Subunit	11- 7(Eve Creek subset):	:	3-28 km of transects
Subunit	11-10	:	8-11 km of transects.

In most years, the population index was calculated from one count of the subunit, although in some years several counts were conducted at intervals to determine the dates of peak concentration. Transects in one subunit were sampled three times at intervals of several days in some years. In these cases, the repeated counts were used to calculate a mean population index and its 95% confidence interval.

DAYLIGHT DEER COUNTS

Daylight counts were conducted by scanning cutovers with binoculars and classifying all deer seen. The observers usually walked along logging roads or through the slash, although some counts were made from vehicles. Daylight counts were effective only during the first and last few hours of daylight and were primarily used to determine population structure. Most daylight counts were conducted in April and May and the deer were classified as either juveniles (11-12 months old) or adults.

Some classified counts were also conducted during July and August to determine the sex ratio of the population and to check the recruitment measured during the spring. In the summer, deer were classified by age class (fawn, yearling: 14-15 months old, adult) and sex (excluding fawns).

The spring counts were used to estimate juvenile recruitment as % juvenile of total deer counted. The summer counts estimated yearling recruitment as % yearling of total deer counted.

The following ranges of sample sizes: total deer classified, were obtained to estimate annual recruitment in the subunits:

Subunits	9-10, 11-1:	113 and 142 deer
Subunit	11- 4	: 45-397 deer, sample sizes exceeded 100 deer in 15 out of 17 years
Subunit	11- 5	: 107 and 138 deer
Subunit	11- 6	: 164-282 deer
Subunit	11-10	: 68-209 deer, sample sizes exceeded 100 deer in 3 out of 4 cases

Counts from several years were often pooled to improve total sample sizes and to provide the narrowest confidence interval calculated by the binomial distribution (Fig. 2b).

The annual productivity of females was estimated by correcting the observed juvenile recruitment in spring with the observed sex ratio that summer. Counts from several subunits were pooled and total samples ranged from 92-718 deer in spring and 117-479 deer in summer.

FOETAL AND NEW-BORN SEX RATIOS

The foetal sex ratio was determined in 1972 and 1973 during a deer collection program undertaken as part of a larger study (Jones, unpubl. data). The new-born sex ratio was determined during capture and tagging of fawns in June of 1974-1980, inclusive.

PELLET GROUP COUNTS

Pellet group counts were also used to determine trends in deer populations. Cleared or uncleared 9.0 m² subplots were established in recent cutovers, second-growth, and old-growth habitats. The uncleared plots were used to corroborate the population trends revealed by the deer counts. Plots which were cleared and counted annually were used to determine population trends in Claude Elliott Creek, an unlogged watershed, where deer counts were not feasible.

WOLF POPULATION AND HUNTER HARVEST DATA

Although the wolf population in the Nimpkish is known to have increased considerably in recent years, detailed population studies have not been carried out in this area. From 1974 through 1977, changes in distribution of wolves in the Nimpkish were determined by mapping sightings of wolves or wolf sign. Quantitative indices of wolf distribution were based on the percentage of daytime transects having evidence of wolf use. The Fish and Wildlife Branch provided additional indices of wolf abundance based on their Hunter Sample program. Although the available data are not measures of absolute wolf density, they do provide indices of relative wolf use over time.

The Fish and Wildlife Branch also provided data concerning hunter kill of deer, success rates, and structure of the kill. These parameters were also estimated annually through the Hunter Sample program.

RESULTS

DEER POPULATION CHANGES

Trends in deer populations and recruitment

Although deer counts have been conducted in almost all subunits within the study area, most effort has been concentrated in the upper and middle Nimpkish areas, comprising subunits 9-10, 11-1, 11-2, 11-4, 11-5, 11-6, 11-7, and 11-10. All of these subunits were partially logged, had good road access, and had substantial hunting pressure.

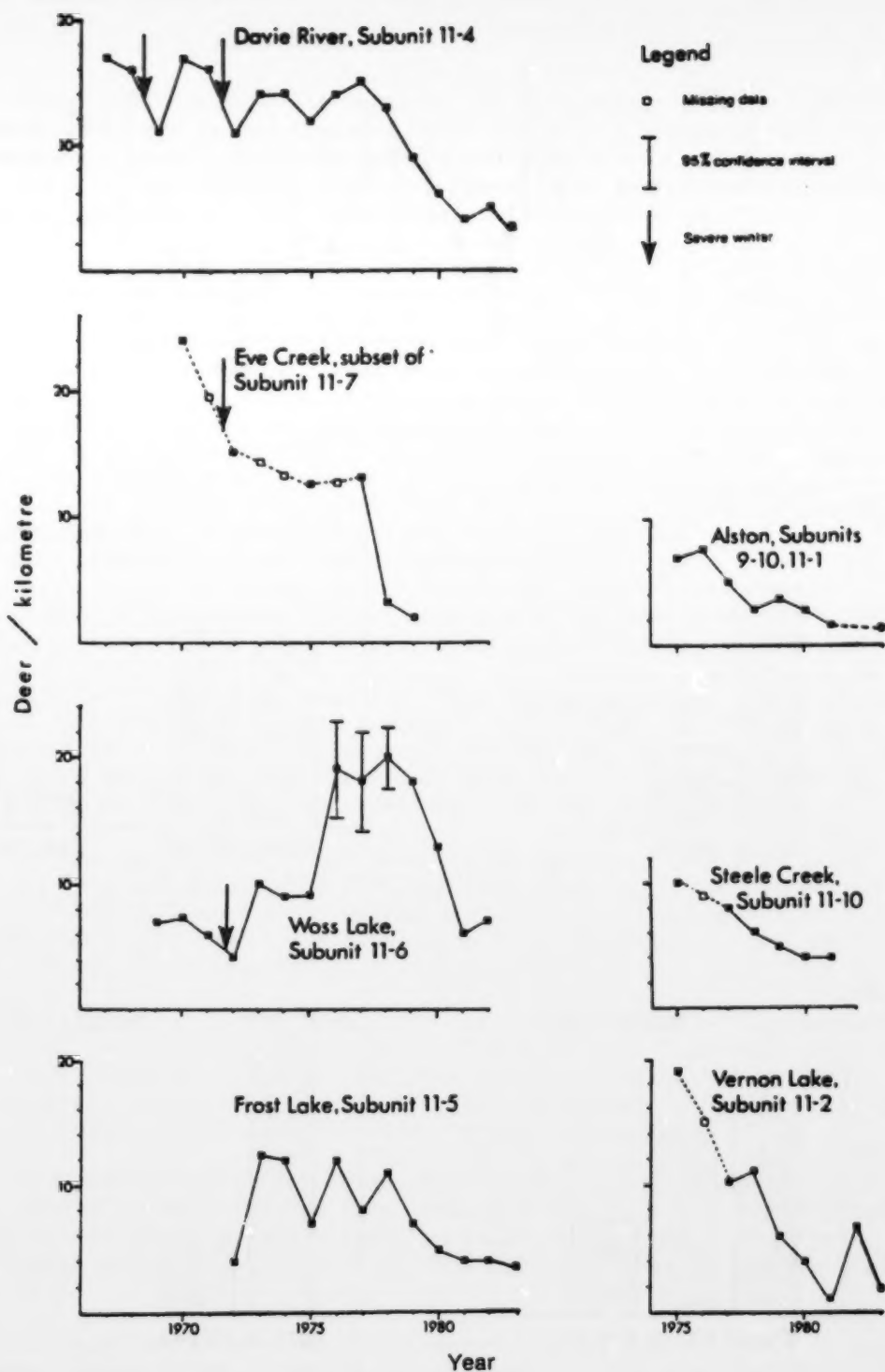
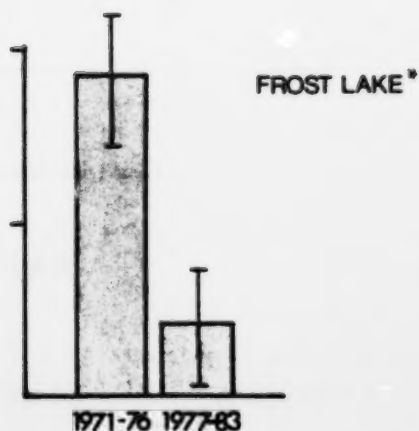
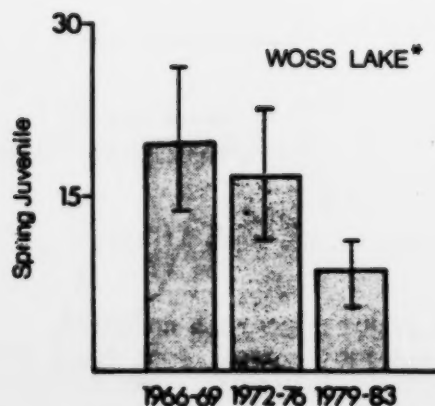
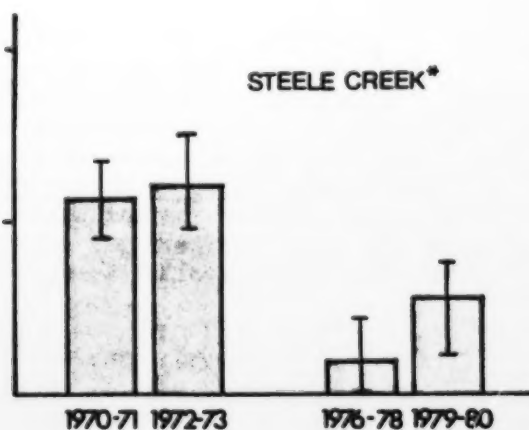
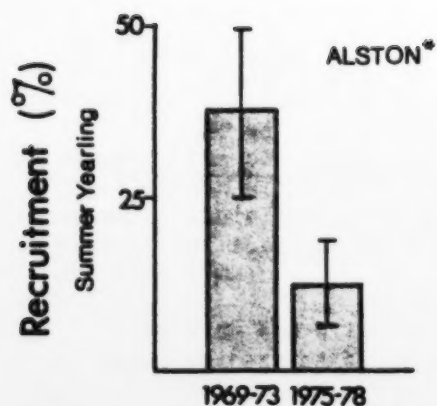
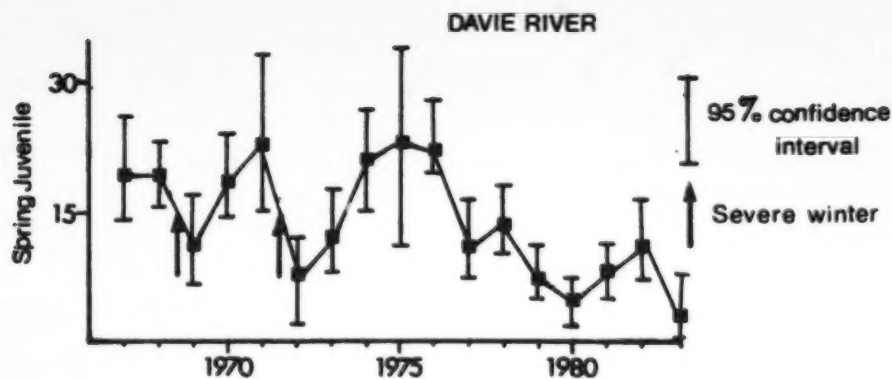


Fig. 2a. Deer population trend - spring population index.



Year

Fig. 2b. Deer population trend - recruitment (* denotes pooled data)

Annual deer counts first began in the Davie River area in 1967 (subunit 11-4) and counts began in other subunits in later years. Consequently, we are unable to compare the population trends in all subunits prior to the early 1970's. However, the later trends in these subunits have generally followed those in the Davie River area.

The deer population in the Davie River area was high in 1967 and 1968 but decreased considerably following the severe winter of 1968-69 (Fig. 2a). The population recovered in 1970 and 1971, but was again depressed by the severe winter of 1971-72. From 1973 through 1978, the population was slightly below the highs of 1967, 1968, 1970, and 1971. However, the population then declined by about 75% from 1978 through 1983. The rate of decline was fastest, about 25% annually, from 1979 to 1981. The population indices for 1982 and 1983 were close to the 1981 index. All population indices from 1979 through 1983 were considerably below those following the two severe winters. This decline occurred during years of mild winters, when field observations indicated that deer were not adversely affected by snow conditions.

Juvenile recruitment has followed trends similar to those of the population index (Fig. 2b). Before 1976, the proportion of juveniles in spring was about 18% - 24% following the mild winters. Recruitment was reduced to about 7% - 11% juveniles after the severe winters of 1968-69 and 1971-72, but recovered quickly. However, after 1976 recruitment decreased substantially to between 12% juveniles in 1982 and 4% in 1983. Although the winters were mild, juvenile recruitment from 1979 through 1983 was similar to, or lower than, that following the two severe winters.

The deer population in the Alston area (subunits 9-10 and 11-1) declined by about 70% between 1976 and 1983 (Fig. 2a). The percentage of yearlings in the summer declined substantially from the early 1970's to the middle 1970's (Fig. 2b). The population index from the nearby Vernon Lake area (subunit 11-2) declined about 90% from 1975 through 1983 (Fig. 2a).

The population in the Frost Lake area (subunit 11-5) increased the year after the 1971-72 severe winter and the indices fluctuated until 1978 (Fig. 2a). From 1978 through 1983, the index declined by about 75% to approximately the level following the 1971-72 winter. Juvenile recruitment declined substantially from 1971-1976 through 1977-1983 (Fig. 2b).

Deer populations in the Woss Lake area (subunit 11-6) were low in the early 1970's but were greater from 1976-1979 (Fig. 2a). The population index then decreased by about 65% from 1978 through 1982. Juvenile recruitment was substantially lower from 1979-1983 than in earlier years (Fig. 2b).

The upper Eve Creek area (Eve Creek subset of subunit 11-7) is used as a summer range by deer. The population index in this area declined by about 90% from 1970 through 1979 (Fig. 2a).

The population in the Steele Creek area (subunit 11-10) declined by about 60% from 1975 through 1981 (Fig. 2a). The percentage of yearlings in the summer was low from 1976-1978 but increased in 1979-1980 (Fig. 2b). However, recruitment was still much lower than in the early 1970's.

The change in the nightcount population index within the Mt. Cain area (subset of subunit 11-4) was confirmed by independent pellet group data from the same area (Table 1). The close agreement between the declines measured by each technique verifies the population changes indicated by the nightcount method.

Table 1. Comparison of changes in pellet group data and nightcount data. Mt. Cain subset of subunit 11-4. The Wilcoxon Matched - Pairs Signed Ranks Test was used to test the significance of the difference between the two pellet group data sets. The subplots were uncleared and were grouped in 17 locations in the study area.

	Pellet group data (groups/subplot)	Nightcount index (deer/km)
1971-72	1.6 n=430	17
1979	0.5 n=680	7
% Change	-69 %	-59%
	T = 0 p < .005	

Female productivity

The inter-annual comparisons of juvenile recruitment do not consider the possible effects of sex ratio. The calculated juveniles:100 females in spring are better indicators of net female productivity (Fig. 3). Female productivity was reduced following the two severe winters, but increased for four years following the 1971-72 winter. However, net productivity then declined drastically and from 1977 through 1982 was similar to productivity following the severe winters.

The observed fawns:100 females in the summer also fluctuated from 1968 through 1980 (Fig. 4). The summertime fawn ratio was substantially reduced following the 1971-72 severe winter but recovered through 1975. (Comparable data were not available after the 1968-69 severe winter.) The fawn ratio declined substantially after 1975, and from 1977 through 1980 was considerably below the level following the severe winter.

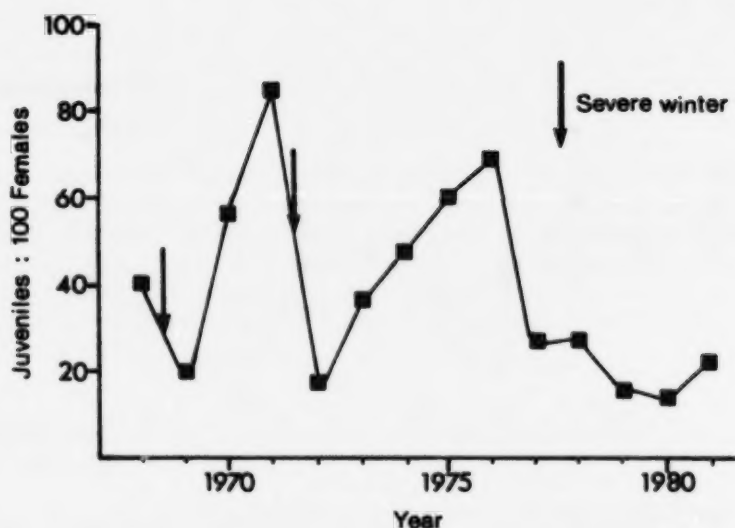


Fig. 3. Calculated annual production of 11 month old juveniles : 100 females (total of subunits 11-4,-5,-6,-7)

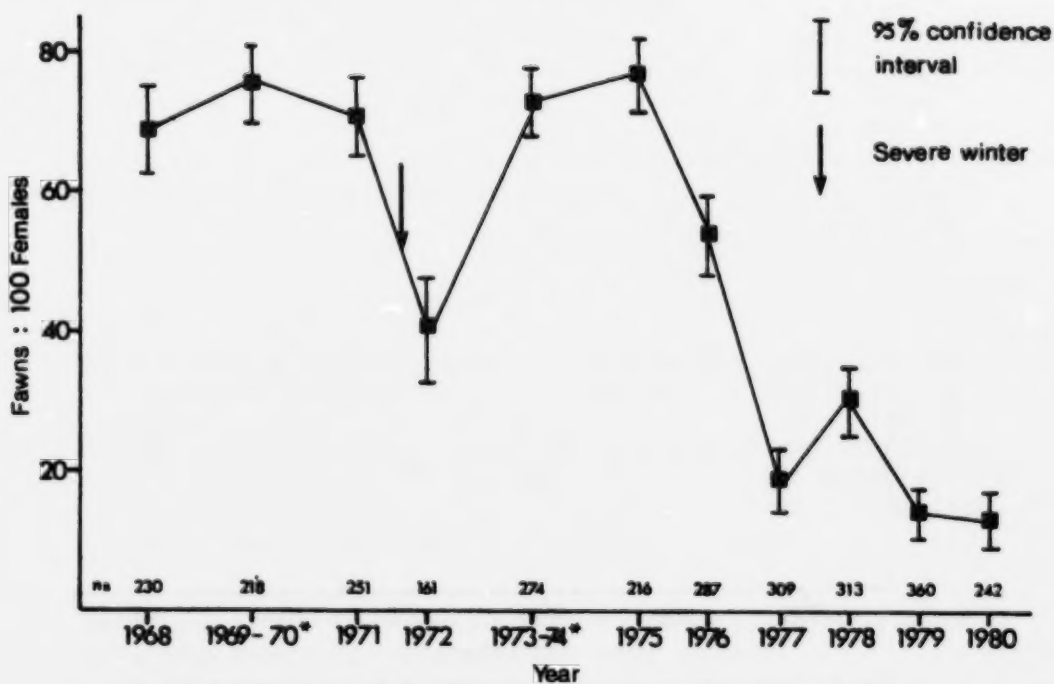


Fig. 4. Observed fawns : 100 females in the summer (total of all subunits; * denotes pooled data).

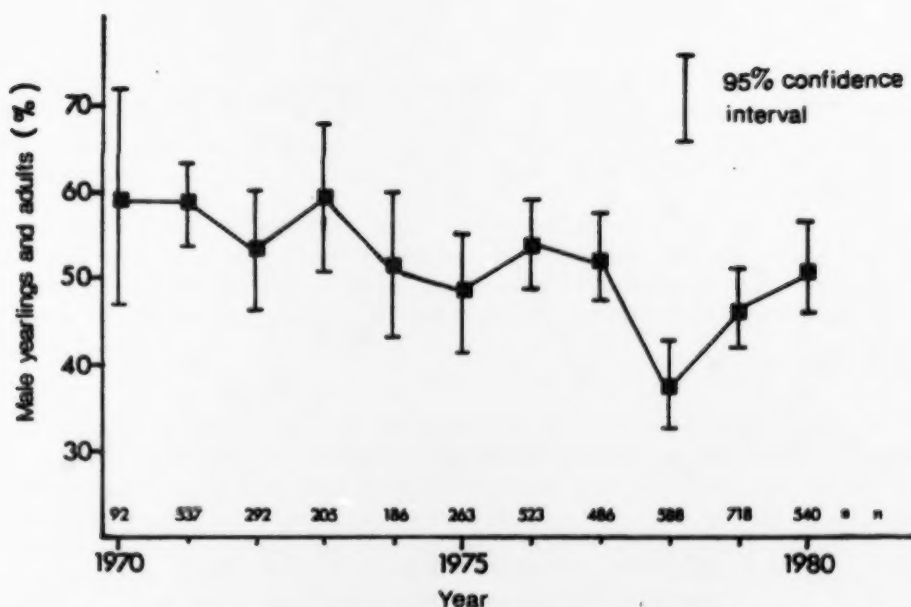


Fig. 5. Observed summer sex ratio (total of subunits 11-4 -5, -6, -7).

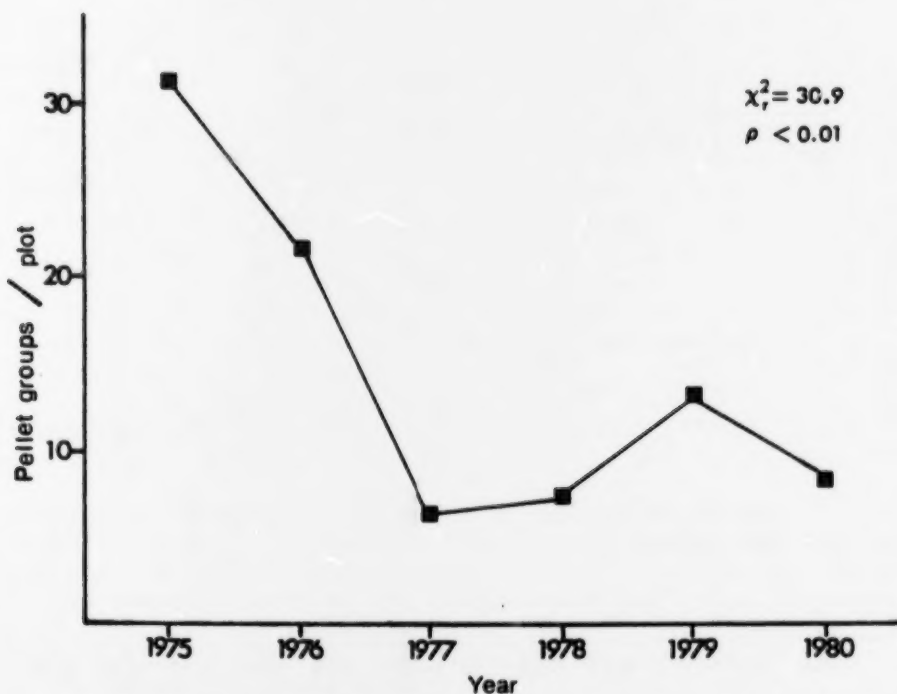


Fig. 6. Deer population trend in the Claude Elliott drainage (all data taken from cleared pellet group plots, 400 subplots in 10 plots; Friedman Two-Way ANOVA was used to test significance)

Sex ratio

The summertime counts indicated that the sex ratio was greater than 50% male for eight out of eleven years between 1970 and 1980. Although the trend was not consistent, the proportion of males may have declined over the 1970's (Fig. 5). The general excess of males over females in the population was likely related to their preponderance at birth. The foetal sex ratio was 59% male (n=29) and the average ratio shortly after birth was 58% male (n=224).

Deer population trend in an unlogged watershed

The relative deer populations within the Claude Elliott drainage (a portion of the Tsitika River, subunit 10-16) were estimated from pellet group plots which were cleared and sampled annually. Nightcounts were impossible in this area because the drainage was unlogged and the first road was built in 1980. The population index decreased considerably between 1975 and 1977 but increased slightly between 1978 and 1980 (Fig. 6). However, the population in 1980 was still about 70% below the 1975 level.

Summary

The population data indicate that the deer populations in the Nimpkish have passed through three general phases:

- 1) 1967-1973: Populations were generally high, with decreases in abundance and recruitment over two severe winters; populations and recruitment increased a year after these winters.
- 2) 1974-1976: Most populations were generally substantial but were below the highs of the earlier period.
- 3) 1977-1983: Populations and recruitment declined substantially, and by 1981 were similar to or below those following the severe winters. The rate of decline was fastest from 1979 to 1981, and was slower afterwards.

While population fluctuations in the various subunits were not identical, they generally conform to the above pattern.

HUNTER HARVEST

Prior to 1964, there was no road access into the Nimpkish and consequently there was only light hunting pressure by local residents. Road access was available in 1964 and outside hunters were quick to discover the high deer populations. Within two or three years, there was heavy hunting pressure, and total harvest and success rates were high until 1978. However, by 1982 the harvest declined by 80%, and success rates fell about 55% from the levels in 1976-1977 (Table 2).

The sex ratio in the hunter harvest remained relatively constant at about 80% males from 1976-1981 (Table 2). The harvest in 1982 was 100% male because the antlerless deer season was discontinued. The fawn:female ratio in the hunter harvest did not follow a clear trend over the study period and averaged 51 fawns:100 females from 1967-1980 (n=925).

Table 2. Hunter Sample information for Management Unit 11. Comparable harvest data were not available prior to 1976.

	Total Deer Harvested	% Males in Harvest	Deer per 100 Hunter-days
1976	1360	80%	11
1977	1455	81%	14
1978	1299	80%	11
1979	712	84%	8
1980	728	83%	8
1981	417	84%	6
1982	258	100%	6

WOLF DISTRIBUTION

In the late 1960's to early 1970's, wolves were sighted infrequently and were considered rare in the Nimpkish. However, sightings became more frequent, and by 1976 wolves were considered fairly common. The wolf sighting indices derived from the Hunter Sample were substantially higher than the averages for Vancouver Island, suggesting that wolf populations in the Nimpkish were relatively high compared to the Island as a whole (Table 3).

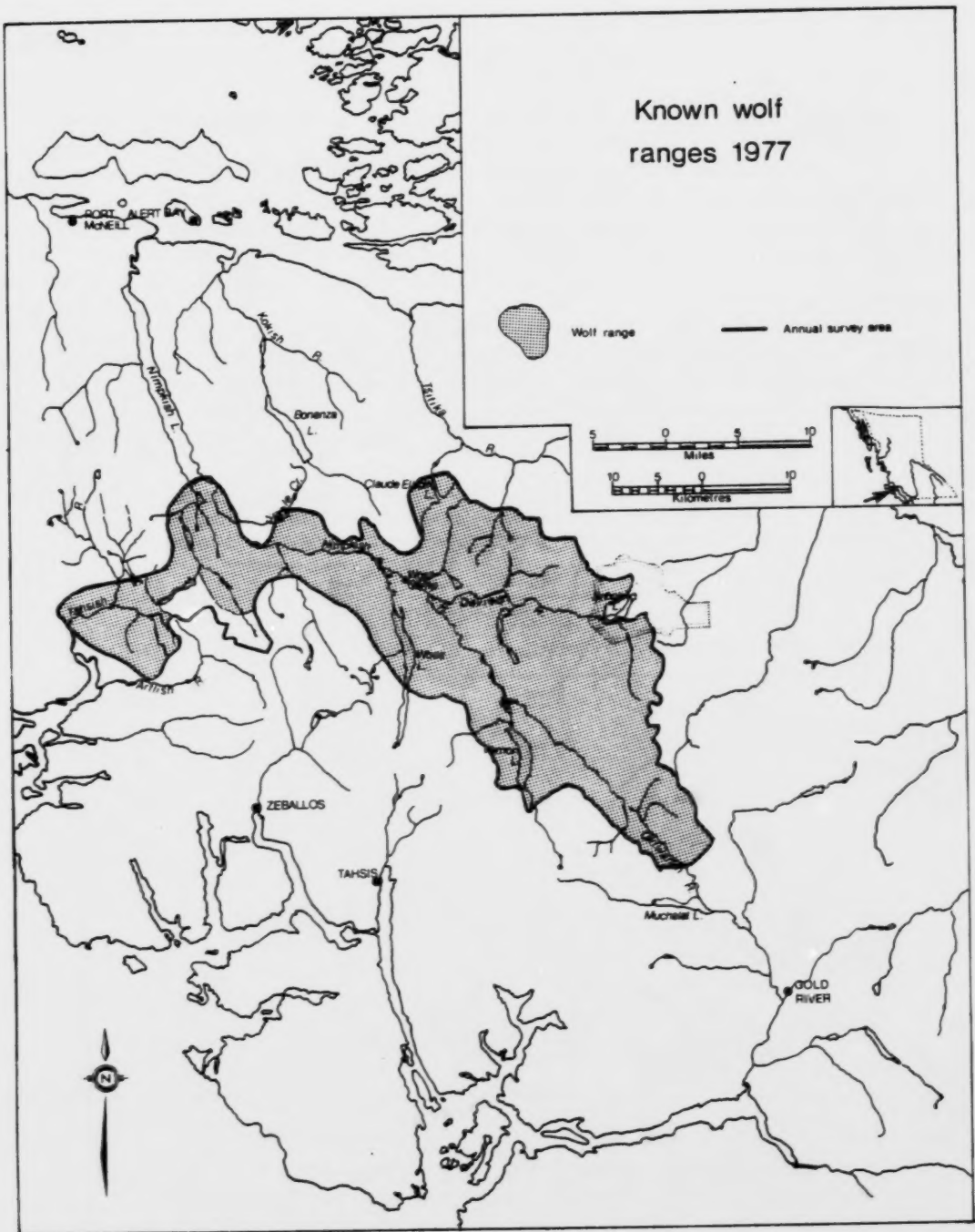


Fig. 7b. Wolf distribution in the Nimpkish in 1977.

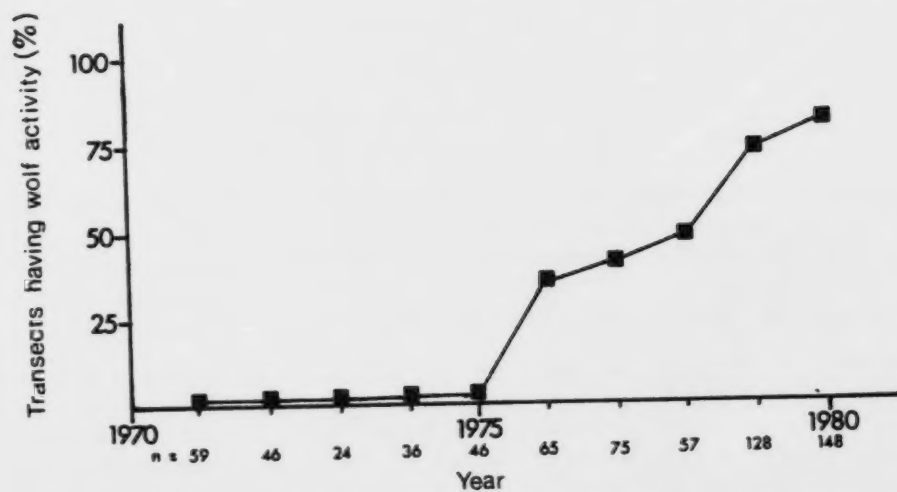


Fig. 8. Proportion of deer count transects having wolf activity.
Total of all subunits.

Table 3. Comparison of wolf sighting indices from the Nimpkish and all of Vancouver Island. Comparable data were not available in other years.

Year	Wolves seen/100 hunter-days	
	Nimpkish M.U.11	Vancouver Island M.U.'s 1-13
1976	2	1
1977	3	1
1978	3	1

Plots of wolf sightings and sign from 1974-1977 indicated that wolf distribution increased greatly over these four years (Figs. 7a, 7b). Wolves remained widely distributed after 1977, and evidence of wolf use was ubiquitous afterwards. Our subjective impressions suggest that wolves were less widespread in 1982 and 1983 than in earlier years.

From 1971 to 1980, we recorded all evidence of wolf-use on daytime deer count transects (Fig. 8). Very few transects had wolf sign between 1971 and 1975, but the percentage increased steadily afterwards, and by 1980 wolf presence was detected on 80% of transects. While the proportion of transects having wolf sign is not a direct index to wolf populations or rates of predation, these data support the observation of greatly increasing wolf distribution during the 1970's.

RELATIONSHIPS BETWEEN DEER POPULATIONS AND WOLF DISTRIBUTION

Although the Claude Elliott area was unhunted because there were no roads, the deer populations declined to a similar extent as the populations in the hunted areas. In an intensive reconnaissance survey in 1971, there was no evidence of wolf use (A. Harestad, pers. comm.). However, wolf scats and tracks were common by 1974, indicating that the population had increased. Wolves and their sign were frequently seen while the deer pellet group data were being collected (Fig. 6).

Substantial wolf activity was first found in the Davie River area in 1977, and deer populations declined considerably within the next two years. In the Woss Lake area, extensive wolf activity was first found in 1979 and deer populations declined substantially within one year. Deer populations had been stable or increasing in each subunit until widespread wolf activity was noted. These comparisons suggest a relationship between wolf presence and subsequent declines in deer populations.

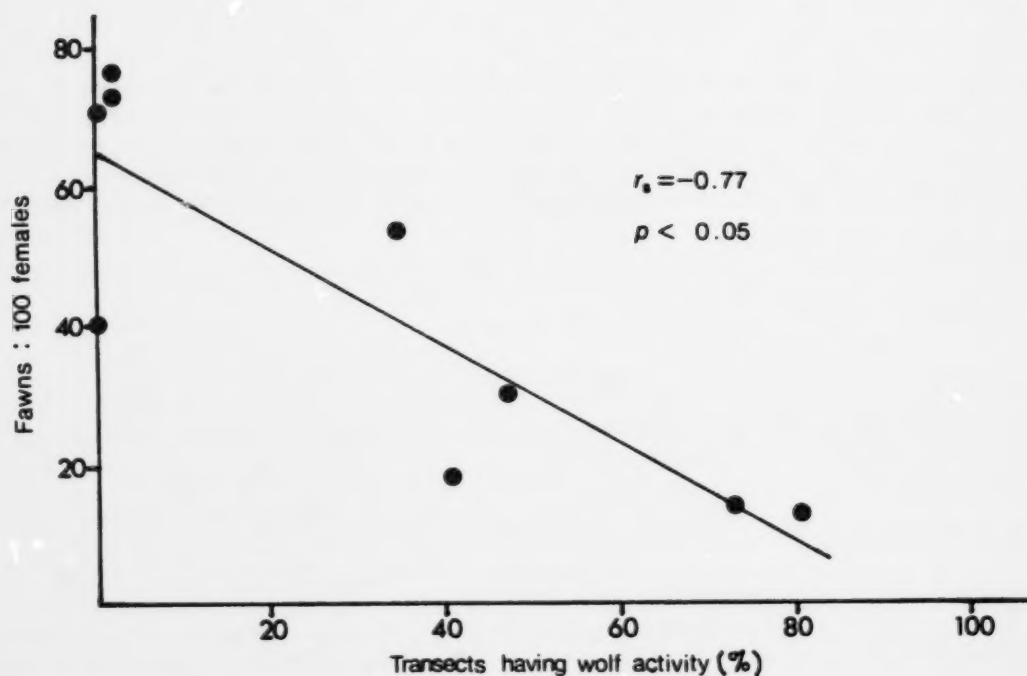


Fig. 9a. Relationship between wolf indices and fawns: females in the summer. Total of all subunits.

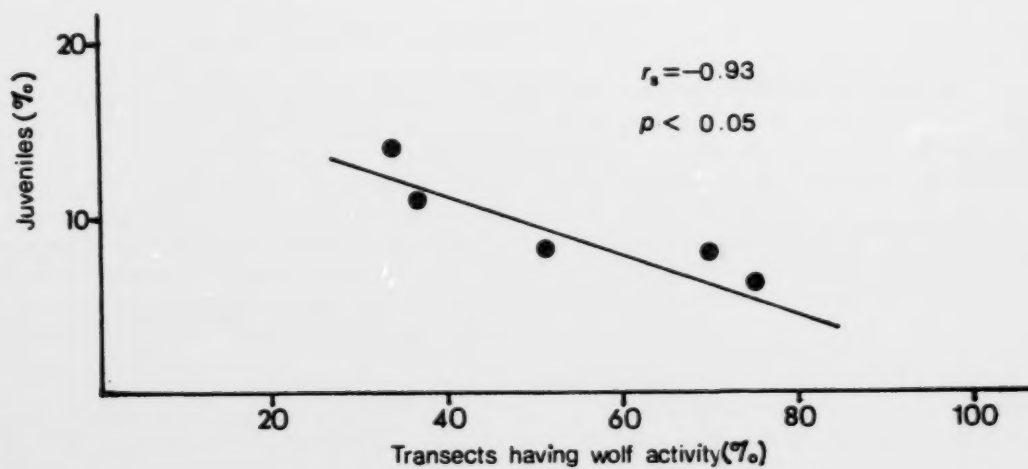


Fig. 9b. Relationship between wolf indices and spring recruitment. Total of all subunits.

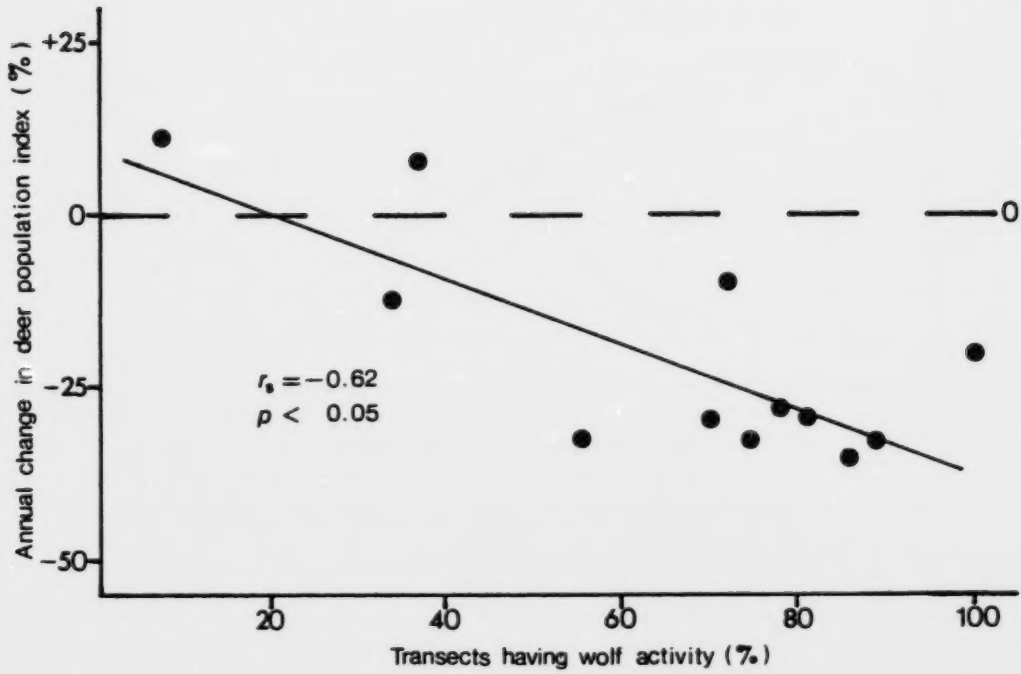


Fig. 10. Relationship between wolf indices and annual deer population changes.
Total of all subunits.

Previously we indicated that deer populations and recruitment declined in the late 1970's. The ratio of fawns:100 females in the summer was negatively correlated with increasing wolf indices (Fig. 9a) as was the juvenile recruitment in the spring (Fig. 9b). Similarly, the annual rates of population decline (Fig. 10) were correlated with increasing wolf activity.

DISCUSSION

DEER POPULATIONS AND WINTER RANGE

The population changes between 1967 and the mid-1970's were considered typical responses to periodic severe winters amongst mild winters. High mortality rates over the two severe winters reduced the deer population. Although males often die at higher rates than females over severe winters (Jones 1975), there was only a minor effect on the observed sex ratio after the 1971-72 winter. Since fawns have higher mortality rates than adults (Jones 1975), the two severe winters decreased net productivity. The higher recruitment and lower mortality rates over mild winters (Jones 1975) allowed the population to increase after the severe winters.

The depressed fawns:100 females in the summer after the 1971-72 winter indicated that the severe conditions caused prenatal and early fawn mortality to increase (Robinette et al. 1957). The summer fawns:100 females in the following years recovered quickly (Fig. 4), suggesting that the females regained their ability to produce fawns within one, or at most two, years. However, the net production of 11 month old juveniles was apparently reduced for four years after the 1971-72 winter (Fig. 3), suggesting that the long-term viability of fawns may have been affected for several years. These results are similar to studies of white-tailed deer (*Odocoileus virginianus*) which found that severe winters depressed productivity of females (Verme 1969).

In severe winters, old-growth winter ranges are essential to minimize deer mortality (Jones 1975). Thus, it is likely that the size of the deer population surviving the two severe winters was primarily related to the extent of remaining winter range. Winters after 1971-72 were generally mild, and most of the winter ranges were maintained and were available to deer if needed. Cutover and unlogged spring and summer ranges were also available. Throughout the 1970's, the Nimpkish had favourable habitat for deer and populations should have increased or at least stabilized. The declines in deer populations after the mid-1970's cannot be attributed to severe winters or to habitat loss resulting from logging. It is particularly important to recognize that deer populations in the unlogged Claude Elliott watershed also declined.

DEER POPULATIONS AND HUNTING

Although hunting pressure and success were generally substantial until the mid-1970's, the harvest did not prevent populations or recruitment from increasing after the two severe winters. However, hunting mortality likely reduced the rate of increase and inhibited recovery to the highs of the earlier period. This dampening effect was not considered serious since populations were still greater than the winter ranges supported over the severe winters. A similar situation occurred in the Northwest Bay area of Vancouver Island where estimated annual harvest rates of 10%-20% did not substantially affect deer numbers in relation to habitat capacity (Smith 1968).

Between 1976 and 1982, deer populations and hunter harvest both declined by over 75%, suggesting that the rate of harvest remained fairly constant. The proportion of males in harvested deer was greater than the proportion in the summer population, indicating that males were harvested at higher rates than females. Thus, hunting of males may have caused the small, although inconsistent, decline in the male ratio since the early 1970's (Fig. 5). This possible effect is not considered serious since the proportion of males approximated 50% in most years. Similarly, the ratio of juveniles:female in the harvest exceeded the observed ratio in most years, suggesting that juveniles were harvested at higher rates than females. Taken together, these comparisons suggest that hunting may have added to the declines in populations and recruitment since the mid-1970's, although the magnitude of the effect cannot be determined. The hunting regulations were revised in 1982 to reduce the harvest. In hindsight, the harvest should possibly have been reduced as soon as the decline was evident.

While hunting may have added to the population reductions since the mid-1970's, the data do not indicate that hunting precipitated the declines. The increases in populations in the heavily hunted Woss Lake area until 1978, while adjacent subunits were declining, and the declines in the unhunted Claude Elliott watershed, support our conclusion that hunter harvest followed, but did not cause, the overall population declines.

DEER POPULATIONS AND WOLVES

The information on wolf distribution (Figs. 7a, 7b, 8), together with our observations over years of deer surveys, indicated that the population in the Nimpkish increased substantially during the 1970's. Wolf populations have also increased in other watersheds on Vancouver Island (Hebert et al. 1982). Since deer are a major component of the diet of Vancouver Island wolves (Scott and Shackleton 1980), it is certain that predation by wolves on deer also increased.

While the estimates of fawns:100 females in the summer were negatively correlated with wolf indices, predation may not have caused all of the observed decline since 1975. Although wolves prey on fawns (Scott and Shackleton 1980), part of the decline may have resulted from increased tendencies of fawns to remain in cover to avoid wolves in the cutovers.

The strong correlations of wolf indices with measures of deer recruitment and rates of population change, all indicate that wolves were responsible for the population declines since the mid-1970's. The extremely low rates of recruitment which occurred when wolves became widespread would not allow populations to increase or remain stable and declines were inevitable. Adult mortality was not measured but must have been substantial to produce population declines of 25% annually for 3 years. Comparison of population trends in various subunits further supports the effect of wolves. Deer populations were not significantly affected by hunting but declined when wolves were widespread, even when hunting was absent.

Similar patterns have also occurred in other jurisdictions. In Minnesota, severe winters and heavy predation by wolves virtually eliminated white-tailed deer from a large area where hunting was inconsequential because of lack of access (Mech and Karns 1977). During a period of mild winters in southeast Alaska, black-tailed deer populations increased substantially in areas without wolf predation but were very low in areas having wolves (Olson 1979). Wolf populations were low in the areas having few deer but were sufficient to prevent the deer from increasing to the habitat capacity.

MANAGEMENT IMPLICATIONS OF PREDATION

The relationships between predator and prey have been studied many times with a variety of results. Connolly (1978) observed that a selective review of the literature can reinforce any desired view of predation. After reviewing many studies, he concluded that the effects of predation vary with the ecological circumstances. Predation can be beneficial to the prey population in some situations and it can be harmful in others. Similarly, predator control will not necessarily benefit the prey population because declining habitat quality, severe weather, over population, or other factors may replace the mortality from predation. In general, predator control is most likely to improve prey populations where the ratio of predators to prey is high and where the forage resources are not fully utilized (Connolly 1978).

A recent review of deer abundance on Vancouver Island found that populations were increasing where wolves were few, but were decreasing where wolves were abundant, even though the habitat was good and winters were mild (Hebert 1981). Similarly, the evidence strongly suggests that wolves have reduced deer populations in the Nimpkish below the capacity determined by habitat and winter conditions. Therefore, the criteria identified by Connolly (1978) suggest that reduction of wolf populations in the Nimpkish may benefit deer. The situation may parallel Minnesota where Mech and Karns (1977) suggested that a 25% reduction of wolves would produce increases in some white-tailed deer populations.

Increases of wolf abundance have been subjectively reported on Vancouver Island several times earlier this century (G. Smith, pers. comm.). Wolves subsequently became scarce for unknown reasons, thus the possibility of a future natural reduction in the Nimpkish must be considered. The reduced rate of deer population decline, and the subjective observation of fewer wolves after 1981, suggest that wolves have already declined. However, substantial increases in the deer will only occur if the predator-prey ratio becomes low enough to allow recruitment greater than the 4% - 12% juveniles recorded over the past few years. Since the recruitment in 1983 was only 4% juvenile, the lowest ever recorded in the Nimpkish, it is unlikely that the deer will recover in the next few years.

When increases in wolves were first noted, wildlife managers did not anticipate that recruitment could fall to 4% - 12% juveniles, or that populations could be reduced by 25% annually for several years. The magnitude of the effects of wolves on deer had not been documented in British Columbia. The results are especially surprising since deer in the Nimpkish were not predisposed to predation by severe winters or poor habitat. The relatively short period required for wolves to affect deer, and the probable ability of wolves to reduce deer without predisposing factors, must therefore be considered in management decisions.

While hunting was not responsible for the recent declines in the deer population, hunting mortality is likely additive to predation. It would be prudent to reduce hunting mortality when wolves become abundant. However, reduction of harvest will not stabilize populations unless predation is also reduced.

Most wildlife management effort in the Nimpkish has attempted to maintain good deer habitat. Although habitat quality is important, predation can seriously undermine the effectiveness of habitat management. The probable future predation regime, and the resulting deer populations, should be considered when planning the level of habitat management.

Important winter ranges in the Nimpkish were deferred from logging to maintain nuclei of deer populations through periodic severe winters. Once logged, the forest would take several hundred years to re-create suitable winter range. Biologists were able to justify the deferrals to the land managers on the strength of the high deer populations existing at the time. However, populations are presently lower than those following the past severe winters and are insufficient to utilize fully the protected habitats. The long term welfare of deer and other wildlife which inhabit old-growth forests will suffer if deer populations are inadequate to continue justification for retention of the forested winter ranges.

Evaluation of the information concerning deer in the Nimpkish indicates that all factors affecting deer must be managed if substantial populations are desired. Once population objectives are set, the required winter ranges must be maintained and hunting must be regulated. When abundant, predators must also be managed if the habitat capabilities are to be realized. The relationships between predators, deer populations, and habitat management must be considered if predator control is contemplated.

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